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The Effects of NTA on the Chlorine Demand of Various Types of Water

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The object of the study was to investigate the effects of NTA (Tri-Sodium Salt of Nitrilo Triacetic Acid, N-(CH2COONa)3) on chlorine demand in various type of waters. Also, to be noted, was the effect on chlorine demand under different conditions of chlorine concentration, NTA concentration, NTA types, temperature, pH, and time of contact.

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THE EFFECTS OF NTA ON THE CHLORINE DEMAND OF VARIOUS TYPES OF WATERS

Technical Report

by

Edward L. Katz

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ENVIRONMENTAL PROTECTION AGENCY

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Edward L. Katz

Northeastern Water Supply Laboratory
Office of Water Programs

1 July 1971

THE EFFECTS OF NTA ON CHLORINE DEMAND ON VARIOUS WATERS

OBJECT: The object of this study was to investigate the effects of NTA (Tri-Sodium Salt of Nitrilo Triacetic Acid, $N-(CH_2COONa)_3$) on chlorine demand in various type of waters. Also, to be noted, was the effect on chlorine demand under different conditions of chlorine concentration, NTA concentration, NTA types, temperature, pH, and time of contact.

MATERIALS: All free chlorine residuals was analyzed using the Wallace and Tiernan (A-790) Amperometric Titrator.

Waters investigated included:

A. Very low or zero demand NEWHL double glass distilled, low conductivity water.

B. Potable Waters:

1) NEWHL (Narragansett) tap water

2) Providence City System tap water (at two different pH's)

3) North Kingstown water

4) Partially treated Potomac River water (collected March 1970)

5) West Kingston well water

6) Newport City water

C. 1) South County, R. I. Surface Waters:

i) Tucker Pond

ii) Worden's Pond

iii) Peacedale Pond

2) Northern Rhode Island Surface Waters:

i) Spring Lake (Burrillville)

ii) Scituate Reservoir

D. 1) "Commercial" NTA Sample -
The Soap & Detergent Association
485 Madison Avenue, New York, New York 10022
NTA Batch #1, June 1970

2) Re-Crystallized NTA-NA3
Hampshire Chemical Co.
("Pure" Chemical)

E. Chlorine Solution - Stock Chlorine Solutions are prepared from:

1) Sodium Hypochlorite
HTH^{R} Granular - Type 1
Olin Chemicals Division
Olin Mathieson Chemical Corporation
745 Fifth Avenue, New York, New York

PROCEDURES:

One liter volumes of the various waters under investigation were prepared. In the case of high demand waters such as the South County Surface Waters, it was necessary to pre-chlorinate the waters to a high degree in order to satisfy the demand and tnen proceed as normal.

A set of four flasks were made up to contain 0 (Blank), 4, 10, and 25 ppm NTA. Chlorine Solution was then added so as to bring the concentrations to 0.5, 1.0, and 2.0 ppm chlorine. The free chlorine residuals were measured at 0 time, 1 hr, 2 hrs, 3 hrs, and after 4 hrs standing.

Experiments were conducted using both Commercial type NTA (TABLE A), and a Re-Crystallized NTA (TABLE B) at 4° and 23°C. The pH of all the waters was measured. All results were corrected by the blank reading (0 ppm NTA), in order to obtain the true picture of the NTA effect upon the chlorine demand.

A second type of experiment was carried out to show any possible effect of NTA upon standing in the waters being tested. Essentially, the water was at its natural pH state or in a buffered state (Providence water at pH 6.5). NTA in various amounts was added to the water in the one liter flasks. At intervals of 0, 1, 2, 3, and 4 hrs, a sample was taken, chlorinated, and chlorine demand is rated. (TABLE C)

RESULTS: (TABLE A) - Commercial NTA

A. Low conductivity water (pH 5.75):

1) NTA has virtually no effect on the chlorination demand of this water up to four hours of contact. At high (2 ppm) chlorine content, 23° temperature, and four hours contact, the NTA affects the chlorine demand to one extent of about 10%. That is, 10% more chlorine is required at this condition to maintain the desired levels.

B. Potable Waters:

1) Potomac River Water (pH 6.9):

Whereas the Potomac River Water by itself contributed to a substantial chlorine demand on the course of the four hour test, the additional effect of the NTA appears to be minimal requiring only 5% - 10% more chlorine at the four hour interval at 2 ppm Cl_2 levels.

2) Providence City Water (pH 10 and also buffered to pH 6.6):

At a pH of 10 the NTA contributed to a maximum of 5% increase in demand at 4°C temperature and 10% increase in demand at the 23° temperature. As is the case in all experiments, the 25 ppm NTA produces greater demand than the lower concentrations. In most cases there is no great increase in demand under four hours.

3) West Kingston, R. I. Well Water (pH 5.82):

NTA apparently breaks down in this acidic water and contributes greatly to the chlorine demand at 23°C. Thus at both the 1 and 2 ppm Cl_2 levels, the chlorine demand at 25 ppm level is almost twice that normally required, i.e., a 98% increase at 1 ppm and 75% increase at 2 ppm. At 4°C no great increase in Cl_2 demand is observed until 3 hours of reading.

4) Newport City Water (pH 7.55):

At 23°C no greater than a 10% increase in Cl_2 demand with NTA is noted at the 1.0 and 0.5 ppm Cl_2 levels. At the 2.0 ppm chlorine level a >10% increase at 25 ppm is noted after 3 hours of standing.

5) NEWHL Lab (pH 6.6):

Up to 3 hours no greater than a 10% increase in chlorine demand is noted at all temperatures and chlorine levels. After 3 hours a 20% increase is reported with one 0.5 ppm level, and with 1.0 ppm. At 4 hours a 20% increase is noted with the 2 mg/l level.

6) North Kingstown (pH 6.5):

At the low temperature and time intervals up to 3 hours, only a 10% increase in chlorine demand is seen. Whereas, at the 23°C temperature at the 3 and 4 hour time intervals chlorine demand increases reach 50%. Thus the effect of an acidic condition of the water is seen.

C. Surface Waters:

1) The South County ponds investigated (pH 6.0) have an extremely high natural inherent chlorine demand. Thus, the effect of NTA in comparison to the overall demand is relatively slight. However, when the natural demand is satisfied to a great extent (90%), NTA contributed a 10% maximum increase at 2 hours and no more than 15% increase at 3 and 4 hours.

2) Spring Lake and Scituate Reservoir (pH 6.0):

These lakes while acidic have no great natural demand compared to the South County ponds and are relatively "pure" water sources. At 4°C a maximum of 10% increase in demand is observed for the highest NTA concentration. At 23°C at 3 and 4 hours, we have a 30 - 40% increase in Cl_2 demand at 25 ppm and 10% increase at 4 ppm.

RESULTS: (TABLE B) Re-Crystallized NTA

A. Low conductivity water - glass distilled:

1) NTA has virtually no effect on increasing Cl_2 demand under most conditions. With the 2.0 ppm Cl_2 and 25 ppm NTA at 23°C, a 6% increase in demand is noted.

B. Potable Waters:

1) Providence City water (pH 10):

NTA contributes about a 10% increase in demand with 25 ppm at 23°C. In most all cases the increase in demand is in the order of 5% or less.

2) Providence Water (Buffered to pH 6.5):

Under this acidic condition the Cl_2 demand for the 2 ppm Cl_2 with 25 ppm NTA at 4 hours exceeds a 15% increase. However, for most all other conditions, the demand increase from the re-crystallized NTA is under 10%.

3) West Kingston Well Water (pH = 5.82):

Under 2 hours and at the 4°C temperature, the increase in demand is generally 10% or under. However, at 4 hours and 25 ppm NTA we have a 15% increase at the 2.0 ppm concentration. At 3 and 4 hours standing at 23°C, NTA contributes from 10 - 20% increase at 4 ppm NTA to a maximum increase of 50% at 25 ppm NTA at 4 hours.

With the 1 ppm Cl_2, NTA contributes a maximum of 50% at the

high of 25 ppm NTA and 4 hours standing.

At the 0.5 ppm concentration, NTA will increase the chlorine demand about 40%.

Thus, with this source of water we can see NTA has a great effect on chlorine demand at 23°C and 3 - 4 hours contact time.

4) New port City Water:

Whereas the city water itself manifests up to a 50% demand in itself, the addition of NTA to this basic (pH 7.6) water contributes to no more than 10% demand and in most cases much less.

5) NEWHL Tap Water:

In general NTA contributes to the increased chlorine demand. Only in two instances 1 ppm Cl_2, 23°C, 4 hours, 10 and 25 ppm, did the increase on demand reach 20%. In general, the water by itself had a very low demand, and the demand increases due to NTA were below 10%.

6) North Kingstown (pH 6.5):

At the 4°C temperature, NTA did not increase chlorine demand by more than 10%. However, at 2 hours contact time at 23°C, NTA made large contributions to chlorine demand. From 4 ppm through 25 ppm at 3 and 4 hour intervals, the demand increase ranged from 15% to 60% at 2 ppm Cl_2, 40% - 80% with 1 ppm Cl_2, and 30 - 60% with 0.5 ppm Cl_2.

C. Surface Waters:

1) South County - Worden's Pond (pH 6.0):

This water indicates a large inherent natural demand, and at 2 hours contact time at 23°C., 25 ppm NTA, the chlorine demand increased to over 15%.

2) Spring Lake (pH 6.0):

Under 2 hours contact time NTA contributed in general to about 10% increase in demand. However, at the 23°C temperature and at 3 and 4 hours contact time, the increase in demand ranged from 20% to 50%.

SPECIAL STUDY (TABLE C)

Several samples of water at various pH ranges and types were subjected to contact with NTA prior to chlorination and measurement.

1) Glass distilled conductivity water:

This source shows no increase in demand with up to 4 hours of contact time with 25 ppm NTA. At 4 hours a 2% increase is observed.

2) NEWHL Lab water (pH 6.6):

It shows no more than a 2 - 3% increase in chlorine demand up to 4 hours of contact with 4, 10, and 25 ppm NTA.

3) Providence City water (pH 10.0):

From 0 - 4 hours contact time with NTA at 25 ppm, an increase in demand ranged from 2 - 6%.

4) Providence water (buffered to 6.5 pH):

Virtually no increase in demand is seen.

5) Potomac River water (pH 6.9):

With 25 ppm NTA and contact time from 0 - 4 hours, an increase in Cl_2 demand from 0 - 6% is observed.

6) West Kingston Well water (pH 5.8):

With 25 ppm NTA and from 0 - 4 hours contact, the increase in demands averages only about 2%.

In general, this experiment demonstrated that contact between NTA and its reacting waters, prior to chlorination, contributes only a few % points increase in chlorine demand.

CONCLUSIONS:

From data obtained on this study, we may conclude that NTA affects chlorine demand to varying degrees depending on various factors.

1) Temperature gradient: From 4° - 23° levels, the NTA effect may be doubled in some cases. Therefore, an increase in temperature can cause NTA to react with its waters to contribute to an increase in chlorine demand.

2) pH: NTA is more reactive as the acidity is increased, and contributes to more chlorine demand. Waters with basic pH conditions are much more stable to the effects of NTA.

3) Concentration: The effects of NTA on chlorination rise predictably with increased amounts of NTA. The 25 ppm level increased demand over the ppm by a factor of 2 or more with the 10 ppm level falling in between generally.

5) NTA - NA_3 "types"

Commercial NTA versus the Re-Crystallized NTA:

Several experiments were conducted with the same parameters quid pro quo using both types of NTA.

No real difference in activity is discerned, and in general we may conclude that their effect on chlorine demand is the same.

6) General Conclusions:

NTA up 2 hours of contact with various waters exhibits a 10% increase in chlorine demand. Under conditions of high temperature 23°, high concentration NTA (10 and 25 ppm), and acidic pH, certain waters may increase its chlorine demand 50% with NTA.

Edward L. Katz

Effects of NTA upon Chlorination

Location : 2X Glass Distilled H_2O
pH : 5.25
Date : Nov-Dec 1970

Type of NTA used: Commercial Grade

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T 23° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1	0.50	0.50	0.50	0.51	0.51	0.53	0.53	0.55	0.55	0.50	0.56	0.51	0.59	0.54
2	0.53	0.55	0.52	0.56	0.55	0.59	0.58	0.53	0.54	0.51	0.58	0.55	0.57	0.54
3	0.53	0.53	0.50	0.55	0.52	0.58	0.55	0.54	0.54	0.50	0.58	0.54	0.59	0.55
4	0.51	0.55	0.54	0.53	0.52	0.58	0.57	0.55	0.58	0.53	0.60	0.55	0.60	0.57
			1.0 ppm Cl_2											
0 hr	1.00	1.02	1.02	1.01	1.01	1.05	1.05	1.00	1.00	1.00	1.00	1.00	1.02	1.02
1	1.03	1.03	1.03	1.04	1.04	1.05	1.05	1.01	1.02	1.01	1.00	1.00	1.03	1.02
2	1.02	1.05	1.03	1.04	1.02	1.08	1.06	1.00	1.00	1.00	1.03	1.03	1.03	1.03
3	1.02	1.05	1.03	1.06	1.04	1.07	1.05	1.00	1.03	1.03	1.04	1.04	1.02	1.02
4	1.02	1.04	1.02	1.02	1.00	1.04	1.02	1.03	1.12	1.07	1.12	1.09	1.16	1.13
			0.5 ppm Cl_2											
0 hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.01	2.01	2.00	2.00	2.02	2.02
1	2.02	2.00	2.00	2.03	2.01	2.02	2.00	2.00	2.01	2.01	2.07	2.07	2.00	2.00
2	2.00	2.00	2.00	2.00	2.00	2.01	2.01	2.03	2.07	2.04	2.08	2.05	2.08	2.05
3	2.07	2.10	2.03	2.05	2.00	2.09	2.02	2.09	2.11	2.02	2.12	2.03	2.11	2.02
4	2.03	2.05	2.03	2.07	2.05	2.10	2.08	2.15	2.20	2.05	2.31	2.16	2.35	2.20

Effects of MTA upon Chlorination

A

ation : Potomac R. M.O. treated
: 69
: Dec 8 1970

Type of MTA used: Commercial Grade

T 4° C

	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
		2.0 ppm Cl_2					
hr	2.28	2.45	2.18	2.46	2.19	2.57	2.29
	2.72	2.79	2.07	2.83	2.11	2.78	2.08
	2.80	2.84	2.04	2.83	2.03	2.83	2.03
	2.75	2.95	2.20	2.88	2.13	2.89	2.14
	3.08	2.95	2.13	3.00	2.08	3.00	2.08
		1.0 ppm Cl_2					
hr	1.30	1.30	1.00	1.36	1.06	1.36	1.06
	1.52	1.65	1.13	1.65	1.13	1.59	1.07
	1.52	1.73	1.21	1.71	1.19	1.71	1.19
	1.67	1.75	1.08	1.76	1.09	1.75	1.08
	1.78	1.81	1.03	--	--	1.79	1.01
		0.5 ppm Cl_2					
hr	0.79	0.82	0.53	0.86	0.57	0.89	0.60
	0.96	0.99	0.53	>1.0	>0.54	>1.0	>0.54
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-

T 23° C

Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
2.30	2.40	2.10	2.49	2.19	2.52	2.22
2.78	2.83	2.05	2.87	2.09	2.88	2.10
2.88	2.92	2.04	2.92	2.04	2.90	2.02
2.98	3.01	2.03	3.04	2.06	3.01	2.03
3.02	3.05	2.03	3.07	2.05	3.12	2.10
1.30	1.37	1.07	1.42	1.12	1.30	1.30
1.60	1.63	1.03	1.67	1.07	1.69	1.09
1.78	1.80	1.02	1.81	1.03	1.80	1.02
1.89	1.92	1.03	1.91	1.02	1.92	1.03
1.92	1.95	1.03	1.94	1.02	1.93	1.01
0.93	0.91	0.50	0.93	0.50	0.94	0.51
0.98	>1	>1	>1	>1	>1	>1
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

4 Readings @ 0 TIME INACCURATE, due to time factor in HIGH OFMND WATER

Effects of NTA upon Chlorination

Location : Providence City Water
pH : 10.0
Date : Dec 16 1970

Type of NTA used: Commercial Grade

T 4° C

T 23° C

2.0 ppm Cl_2

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.22	2.16	2.00	2.13	2.00	2.27	2.05
1	2.32	2.28	2.18	2.25	2.03	2.22	2.00
2	2.33	2.34	2.01	2.35	2.02	2.33	2.00
3	2.32	2.43	2.09	2.38	2.04	2.38	2.04
4	2.40	2.50	2.10	2.40	2.00	-	-

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1	2.15	2.22	2.07	2.26	2.11	2.29	2.14
2	2.27	2.29	2.05	2.38	2.14	2.38	2.14
3	2.34	2.40	2.06	2.40	2.14	2.52	2.18
4	2.33	2.37	2.04	2.52	2.19	2.56	2.23

1.0 ppm Cl_2

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	1.12	1.12	1.00	1.00	1.02	1.00	1.00
1	1.16	1.18	1.02	1.00	1.00	1.18	1.02
2	1.16	1.18	1.02	1.17	1.01	1.20	1.04
3	1.19	1.25	1.04	1.23	1.04	1.25	1.06
4	1.18	1.24	1.06	1.25	1.07	1.24	1.06

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	1.05	1.06	1.04	1.02	1.00	1.09	1.04
1	1.14	1.15	1.01	1.19	1.05	1.23	1.09
2	1.13	1.22	1.09	1.25	1.12	1.26	1.13
3	1.27	1.29	1.02	1.31	1.04	1.35	1.08
4	1.33	1.40	1.07	1.42	1.09	1.44	1.11

0.5 ppm Cl_2

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.61	0.61	0.50	0.62	0.52	0.65	0.54
1	0.70	0.70	0.50	0.73	0.53	0.72	0.52
2	0.75	0.76	0.50	0.76	0.50	0.77	0.51
3	0.77	0.78	0.51	0.78	0.51	0.80	0.53
4	0.79	0.82	0.53	0.82	0.53	0.84	0.55

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.55	0.58	0.50	0.58	0.50	0.62	0.54
1	0.68	0.69	0.51	0.71	0.53	0.72	0.54
2	0.74	0.74	0.50	0.76	0.52	0.76	0.52
3	0.79	0.79	0.50	0.80	0.51	0.81	0.52
4	0.81	0.81	0.52	0.82	0.51	0.84	0.53

cation : PROVIDENCE CITY WATER
: DOSED TO 6.5
te : JAN 1971

Type of NTA used: Commercial Grade

	T 4° C							T 23° C						
			2.0 ppm Cl_2											
e	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
hr	202	202	200	202	200	207	205	223	226	203	230	207	235	212
1	250	250	200	253	203	257	207	262	262	200	264	302	273	211
2	253	255	202	258	205	260	207	265	268	203	292	207	290	235
3	258	261	203	266	208	279	221	275	278	203	281	206	305	239
4	270	274	204	276	206	279	209	287	307	220	331	226	333	246
			1.0 ppm Cl_2											
hr	118	127	109	131	113	131	113	121	121	100	-	-	124	103
	155	155	100	100	105	161	106	145	145	100	-	-	145	100
2	156	160	104	166	110	166	110	152	152	100	-	-	156	104
3	161	164	103	167	106	169	108	158	158	100	-	-	162	104
4	168	-	100	173	105	175	107	160	160	100	-	-	167	107
			0.5 ppm Cl_2											
0 hr	050	043	057	049	051	059	059	060	062	052	065	055	068	058
1	080	088	058	085	055	090	060	055	088	053	092	057	094	059
2	086	094	058	089	053	093	057	096	097	051	098	052	>1.0	>51
3	089	095	056	090	057	>1.0	>.61	>1-	-	-	>1-	-	>1-	-
4	092	098	056	094	052	>1.0	-	>1-	-	-	>1-	-	>-	

Effects of NTA upon Chlorination

A

Type of NTA used: Commercial Grade

Location : West Kingston, RI.
pH : 5.82
Date : Dec 10 '70

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	2.03	2.03	2.00	2.00
1	2.03	2.00	2.02	2.02	2.00	2.01	2.00
2	2.00	2.02	2.02	2.04	2.04	2.17	2.17
3	2.03	2.14	2.11	2.14	2.11	2.42	2.39
4	2.02	2.20	2.18	2.20	2.18	2.57	2.55
			1.0 ppm Cl_2				
0 hr	1.07	1.00	1.00	1.04	1.00	1.05	1.00
1	1.12	1.14	1.02	1.16	1.04	1.18	1.07
2	1.15	1.16	1.03	1.19	1.04	1.20	1.05
3	1.17	1.20	1.03	1.19	1.03	1.33	1.16
4	1.17	1.22	1.05	1.33	1.16	1.38	1.21
			0.5 ppm Cl_2				
0 hr	0.50	0.55	0.55	0.58	0.58	0.57	0.57
1	0.59	0.60	0.51	0.64	0.55	0.67	0.58
2	0.62	0.63	0.51	0.64	0.52	0.69	0.57
3	0.64	0.68	0.54	0.67	0.53	0.70	0.57
4	0.70	0.71	0.51	0.71	0.51	0.75	0.55

T 23° C

Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
2.00	2.01	2.01	2.00	2.00	2.00	2.00
2.05	2.20	2.15	2.20	2.15	2.48	2.43
2.05	2.43	2.38	2.52	2.47	2.90	2.85
2.08	2.44	2.36	2.85	2.77	3.24	3.16
2.05	2.81	2.76	3.05	3.00	3.48	3.43
1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.03	1.03	1.07	1.07
1.03	1.17	1.14	1.35	1.32	1.48	1.45
1.01	1.32	1.31	1.58	1.57	1.78	1.77
1.06	1.47	1.47	1.82	1.82	1.98	1.98
0.56	0.56	0.58	0.59	0.53	0.57	0.53
0.59	0.62	0.53	0.64	0.55	0.71	0.61
0.65	0.68	0.53	0.69	0.57	0.71	0.57
0.70	0.72	0.52	0.73	0.53	0.81	0.61
0.65	0.75	0.63	0.85	0.70	0.92	0.77

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A

Effects of NTA upon Chlorination

Type of NTA used: Commercial Grade

Location : NEWPORT, R.I.
pH : 7.55
Date : FEB 11 71

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.04	2.06	2.02	2.00	2.00	2.10	2.06
1	2.23	2.28	2.05	2.35	2.13	2.32	2.09
2	2.33	2.39	2.06	2.44	2.11	2.43	2.10
3	2.43	2.49	2.06	2.50	2.07	2.53	2.10
4	2.45	2.50	2.05	2.55	2.10	2.55	2.10

Time	Blank	4 ppm	1.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	1.00	1.03	1.03	-	-	1.04	1.04
1	1.10	1.12	1.02	-	-	1.13	1.02
2	1.19	1.25	1.06	-	-	1.26	1.06
3	1.32	-	-	-	-	1.35	1.03
4	1.35	1.39	1.04	-	-	1.41	1.06

Time	Blank	4 ppm	0.5 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.50	-	-	-	-	0.55	0.55
1	0.65	-	-	-	-	0.70	0.55
2	0.69	-	-	-	-	0.74	0.55
3	0.71	-	-	-	-	0.86	0.57
4	0.81	-	-	-	-	0.89	0.58

T 23° C

Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
2.00	2.00	2.00	2.00	2.00	2.02	2.02
2.08	2.08	2.02	2.11	2.03	2.10	2.02
2.20	2.39	2.19	2.45	2.25	2.40	2.20
2.45	2.70	2.25	2.75	2.28	2.82	2.37
2.55	2.65	2.10	2.85	2.30	2.95	2.40

Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
1.00	1.00	1.00	1.00	1.00	1.02	1.01
1.08	1.11	1.03	1.11	1.03	1.12	1.04
1.18	1.25	1.07	1.31	1.13	1.34	1.16
1.37	1.42	1.05	1.46	1.09	1.45	1.10
1.43	1.48	1.05	1.50	1.07	1.57	1.14

Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0.50	0.52	0.52	0.52	0.52	0.52	0.52
0.57	0.57	0.50	0.62	0.55	0.65	0.58
0.63	0.70	0.57	0.79	0.66	0.78	0.65
0.75	0.76	0.51	0.76	0.51	0.80	0.55
0.86	0.90	0.54	0.92	0.56	0.92	0.56

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Effects of NTA upon Chlorination

Type of NTA used: Commercial Grade

Location : NEWHL TAP H2O
pH : 6
date : DEC 19XX

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1	2.08	2.08	2.00	2.08	2.00	2.12	2.04
2	2.25	2.30	2.05	2.30	2.05	2.33	2.08
3	2.20	2.30	2.10	2.33	2.13	2.29	2.09
4	2.25	2.40	2.15	2.42	2.17	2.50	2.25

Time	Blank	4 ppm	1.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	1.00	1.02	1.02	1.02	1.02	1.03	1.03
1	1.08	1.04	1.04	1.04	1.04	1.04	1.04
2	1.07	1.04	1.04	1.05	1.05	1.08	1.08
3	1.02	1.09	1.07	1.11	1.09	1.11	1.09
4	1.02	1.07	1.05	1.06	1.04	1.09	1.07

Time	Blank	4 ppm	0.5 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1	0.53	0.52	0.50	0.54	0.51	0.60	0.57
2	0.57	0.57	0.57	0.58	0.51	0.58	0.51
3	0.57	0.57	0.57	0.60	0.53	0.62	0.55
4	0.62	0.65	0.53	0.70	0.58	0.67	0.55

T 23° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.02	2.02	2.02	2.02	2.03	2.02
1	2.00	1.98	2.02	1.96	2.04	2.01	2.01
2	2.00	2.00	2.00	1.95	2.05	2.11	2.11
3	2.00	2.02	2.02	2.01	2.01	2.13	2.13
4	2.00	2.10	2.10	2.18	2.18	2.30	2.30

Time	Blank	4 ppm	1.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	1.00	1.01	1.05	1.05	1.05	1.05	1.05
1	1.00	1.06	1.06	1.06	1.03	1.06	1.06
2	1.00	1.06	1.06	1.05	1.08	1.08	1.05
3	1.04	1.06	1.02	1.10	1.06	1.13	1.09
4	1.06	1.19	1.13	1.16	1.10	1.25	1.19

Time	Blank	4 ppm	0.5 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.50	0.50	0.50	0.53	0.53	0.53	0.53
1	0.50	0.50	0.50	0.56	0.56	0.56	0.56
2	0.50	0.50	0.50	0.59	0.59	0.60	0.60
3	0.50	0.52	0.52	0.60	0.60	0.62	0.62
4	0.52	0.59	0.57	0.63	0.61	0.69	0.67

Effects of NIA upon Chlorination

cation : North Kingstown, RI

: 65

te : FEB 17 1971

Type of NIA used: Commercial Grade

T 4° C

T 23° C

	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
				2.0 ppm Cl_2			
hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	2.14	2.19	2.05	2.14	2.00	2.15	2.01
	2.04	2.13	2.09	2.08	2.04	2.15	2.11
	2.02	2.22	2.20	2.26	2.24	2.31	2.29
	2.02	2.12	2.10	2.27	2.25	2.45	2.43
				1.0 ppm Cl_2			
hr	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.08	1.00	1.00	1.08	1.00	1.10	1.02
	1.06	1.08	1.02	1.12	1.06	1.12	1.06
	1.09	1.14	1.05	1.16	1.07	1.14	1.05
	1.10	1.17	1.07	1.16	1.06	1.19	1.09
				0.5 ppm Cl_2			
hr	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	0.55	0.55	0.50	0.59	0.54	0.58	0.53
	0.58	0.61	0.53	0.62	0.54	0.64	0.56
	0.65	0.68	0.53	0.67	0.52	0.69	0.54
	0.66	0.72	0.56	0.67	0.51	0.69	0.53

	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
				2.0 ppm Cl_2			
hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	2.03	2.03	2.03	2.13	2.13	2.22	2.22
	2.00	2.34	2.34	2.49	2.49	2.75	2.75
	2.00	2.61	2.61	2.77	2.77	3.01	3.01
	2.27	2.77	2.50	3.00	3.73	3.30	3.03
				1.0 ppm Cl_2			
hr	1.01	1.04	1.03	1.00	1.00	1.02	1.01
	1.07	1.08	1.01	1.03	1.03	1.12	1.05
	1.11	1.25	1.14	1.26	1.15	1.38	1.27
	1.15	1.30	1.15	1.38	1.23	1.57	1.42
	1.15	1.41	1.26	1.55	1.40	1.69	1.54
				0.5 ppm Cl_2			
hr	0.53	0.55	0.52	0.55	0.52	0.56	0.53
	0.59	0.59	0.50	0.61	0.52	0.61	0.52
	0.54	0.60	0.51	0.63	0.54	0.67	0.58
	0.62	0.68	0.56	0.72	0.60	0.74	0.62
	0.61	0.69	0.58	0.76	0.65	0.82	0.71

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Effects of NTA upon Chlorination

Type of NTA used: Commercial Grade

A

Location : Tucker Pond, R.I.
ph : 6.0
date : 12-22-78

T 4° C

2.0 ppm Cl_2

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
	(Dose initially @ 3 mg/l + wait 8 hr)						
0 hr	< 2	< 2	< 2	< 2	< 2	< 2	< 2
1	2.28	2.40	2.12	2.43	2.15	2.43	2.15
2	2.58	2.59	2.01	2.74	2.16	2.88	2.30
3	2.97	3.04	2.07	3.09	2.12	3.28	2.31
4	3.14	3.19	2.05	3.25	2.11	3.50	2.36

1.0 ppm Cl_2

	(Dose @ 5 mg/l Cl_2 set overnite)						
0 hr	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.05	1.02	1.00	1.04	1.00	1.09	1.04
2	1.17	-	-	1.12	1.00	1.25	1.08
3	1.28	-	-	1.28	1.00	1.39	1.11
4	1.35	-	-	1.35	1.00	1.47	1.12

0.5 ppm Cl_2

	(Stnd 5 mg/l overnite)						
0 hr	0.50	0.58	0.58	-	-	0.59	0.54
1	0.60	0.64	0.54	-	-	0.72	0.62
2	0.66	0.73	0.57	-	-	0.80	0.64
3	0.80	0.88	0.58	-	-	0.92	0.62
4	0.75	0.82	0.57	-	-	0.92	0.72

T 23° C

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
	(Dose @ 4 mg/l wait 8 hr no sample)						
0 hr	2.29	2.41	2.11	2.35	2.09	2.40	2.11
1	3.17	3.22	2.05	3.25	2.08	3.44	2.27
2	3.57	3.60	2.03	3.70	2.12	3.82	2.25
3	3.83	3.83	2.00	3.90	2.10	3.98	2.15
4	3.97	> 3.97	-	> 3.97	-	3.97	-

	(Dose @ 6 mg/l Stnd overnite)						
0 hr	1.14	1.20	1.06	1.29	1.15	1.30	1.16
1	1.51	1.56	1.05	1.73	1.22	1.86	1.35
2	1.70	1.74	1.04	1.91	1.21	1.98	1.28
3	1.88	> 2	-	> 2	-	-	-
4	-	-	-	-	-	-	-

Peace Dale Pond pH 5.95 @ 23C

	Dose 7 mg/l Cl_2	Stnd overnite	test 2 mg/l				
0 hr	2.18	2.19	2.01	2.21	2.03	2.21	2.03
1	2.88	2.80	2.00	2.82	2.00	2.95	2.07
2	3.19	3.24	2.05	3.29	2.10	3.42	2.23
3	3.49	3.56	2.07	3.61	2.12	3.75	2.26
4	3.70	3.78	2.08	3.80	2.10	3.90	2.20

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Effects of NTA upon Chlorination

Location : Spring Lake, RI.
pH : 6.0
date : Dec 12 1971

Type of NTA used; Commercial Grade

T 4° C

2.0 ppm Cl_2

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.40	2.42	2.02	2.44	2.04	2.51	2.11
1	2.87	2.89	2.02	2.90	2.03	3.02	2.15
2	2.94	2.94	2.00	3.00	2.06	3.12	2.16
3	3.07	3.12	2.05	3.13	2.06	3.22	2.15
4	3.10	3.13	2.03	3.15	2.05	3.30	2.20

1.0 ppm Cl_2

(Dose ± ½ mg/L Cl_2 1hr prior to test.)

0 hr	1.07	1.09	1.02	-	-	1.17	1.10
1	1.49	1.48	1.00	-	-	1.58	1.09
2	1.49	1.52	1.03	-	-	1.63	1.14
3	1.60	1.63	1.03	-	-	1.69	1.09
4	1.66	1.69	1.03	-	-	1.77	1.11

0.5 ppm Cl_2

(Dose ± 1 mg/L Cl_2 1hr before test)

0 hr	0.50	0.58	0.58	0.50	0.50	0.50	0.50
1	0.50	0.51	0.51	0.51	0.51	0.51	0.51
2	0.50	0.50	0.50	0.54	0.51	0.54	0.54
3	0.57	0.57	0.50	0.57	0.50	0.63	0.56
4	0.57	0.58	0.51	0.61	0.54	0.65	0.58

T 23° C

2.0 ppm Cl_2

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.41	2.42	2.01	2.44	2.03	2.57	2.16
1	2.89	2.93	2.04	2.98	2.09	2.98	2.09
2	2.97	3.09	2.12	3.14	2.17	3.28	2.31
3	3.06	3.27	2.21	3.40	2.34	3.56	2.50
4	3.12	3.39	2.28	3.65	2.52	3.82	2.70

1.0 ppm Cl_2

(Dose ± 0.25 mg/L H_2O 90 min. Prior to test)

0 hr	1.00	1.00	1.00	1.06	1.06	1.12	1.12
1	1.16	1.20	1.04	1.24	1.08	1.32	1.16
2	1.28	1.36	1.12	1.43	1.15	1.54	1.26
3	1.38	1.51	1.13	1.59	1.21	1.70	1.32
4	1.39	1.56	1.17	1.62	1.23	1.80	1.41

0.5 ppm Cl_2

(Dose ± mg/L water 2 hrs prior to test)

0 hr	0.50	0.50	0.50	0.55	0.55	0.57	0.57
1	0.53	0.53	0.50	0.55	0.52	0.61	0.58
2	0.61	0.61	0.50	0.68	0.57	0.50	0.69
3	0.65	0.65	0.50	0.74	0.59	0.84	0.69
4	0.78	-	-	0.84	0.54	0.42	0.70

Type of NTA used: Commercial Grade

Location : Scituate Reservoir, R.I.
Site : 61
Date : Jan 12 71

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.35	2.28	2.00	2.28	2.02	2.31	2.00
1	2.70	2.71	2.01	2.79	2.09	2.84	2.14
2	2.79	2.89	2.10	2.93	2.14	2.99	2.20
3	2.89	2.99	2.10	3.07	2.18	3.16	2.27
4	2.94	3.06	2.12	3.11	2.17	3.32	2.38

Time	Blank	4 ppm	1.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	~~0.09~~	-	-	-	-	-	-
1	1.27	1.10	1.00	1.28	1.01	1.31	1.04
2	1.54	1.70	1.11	-	-	1.69	1.10
3	1.71	1.74	1.08	-	-	1.78	1.07
4	1.78	1.83	1.05	-	-	1.86	1.08

Time	Blank	4 ppm	0.5 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.72	0.74	0.52	0.74	0.52	0.75	0.53
1	0.91	0.95	0.54	0.96	0.55	1.00	0.59
2	-	-	-	-	-	-	-
3							
4							

T 23° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.35	2.37	2.03	2.42	2.07	3.50	2.15
1	2.62	2.94	2.12	3.01	2.19	3.10	2.28
2	2.92	3.11	2.27	3.32	2.40	3.51	2.54
3	3.16	3.30	3.14	3.47	2.31	3.75	2.45
4	3.16	3.52	2.36	3.60	2.44	3.95	2.79

Time	Blank	4 ppm	1.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	-	-	-	-	-	-	-
1	1.38	1.43	1.05	1.49	1.12	1.45	1.06
2	1.67	1.75	1.05	1.77	1.10	1.77	1.10
3	1.75	1.82	1.07	1.82	1.07	1.85	1.10
4	1.89	1.95	1.06	1.98	1.10	2.00	>1.11

Time	Blank	4 ppm	0.5 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	0.72	0.82	0.60	0.80	0.58	0.85	0.63
1	0.86	0.96	0.60	>1	>.64	>1.0	>.64
2	0.95	>1.0	>.65	>1	>.65	>1.0	>.65
3							
4							

Effects of NTA upon Chlorination

B

Location : LAB GLASS 2x Dist. H_2O
pH : 5.75
date : MAY 1971

Type of NTA used: Recrystallized

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2	2.00	2.00	2.00	2.00	2.00	2.00	2.00
3	2.00	2.00	2.00	2.00	2.00	2.00	2.00
4	2.00	2.00	2.00	2.00	2.00	2.00	2.00
			1.0 ppm Cl_2				
0 hr	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	1.00	1.00	1.00	1.04	1.04	1.04	1.04
4	1.00	1.00	1.00	1.02	1.02	1.02	1.02
			0.5 ppm Cl_2				
0 hr	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1	0.50	0.50	0.50	0.50	0.50	0.50	0.50
2	0.50	0.50	0.50	0.50	0.50	0.50	0.50
3	0.50	0.50	0.50	0.50	0.50	0.50	0.50
4	0.50	0.50	0.50	0.50	0.50	0.50	0.50

T 23° C

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1	2.00	2.00	2.00	2.00	2.00	2.02	2.02
2	2.00	2.00	2.00	2.03	2.03	2.06	2.06
3	2.00	2.00	2.00	2.03	2.03	2.03	2.03
4	2.00	2.08	2.08	2.00	2.00	2.06	2.06
0 hr	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1.00	1.03	1.03	1.00	1.00	1.00	1.00
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0 hr	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1	0.52	0.52	0.52	0.45	0.55	0.50	0.50
2	0.50	0.45	0.50	0.48	0.52	0.52	0.50
3	0.50	0.50	0.50	0.50	0.50	0.50	0.50
4	0.50	0.50	0.50	0.50	0.50	0.50	0.50

6/1

Effects of NTA upon Chloridation

Location : Providence City Water
pH : 10.0
date : MAY 71

Type of NTA used: Recrystallised

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	-	-	2.00	2.00
1	2.12	2.22	2.10	-	-	2.22	2.10
2	2.13	2.19	2.06	-	-	2.23	2.10
3	2.20	2.33	2.13	-	-	2.35	2.15
4	2.35	2.42	2.17	-	-	2.39	2.14
			1.0 ppm Cl_2				
0 hr	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.01	1.01	1.01	1.01	1.01	1.05	1.05
2	1.03	1.08	1.08	1.08	1.05	1.17	1.14
3	1.07	1.13	1.06	1.14	1.07	1.17	1.10
4	1.15	1.28	1.13	1.26	1.10	1.32	1.17
			0.5 ppm Cl_2				
0 hr	0.55	0.55	0.50	0.55	0.50	0.56	0.51
1	0.64	0.64	0.50	0.66	0.52	0.66	0.52
2	0.64	0.67	0.53	0.68	0.54	0.70	0.56
3	0.69	0.70	0.51	0.71	0.52	0.74	0.55
4	0.74	0.77	0.53	0.76	0.52	0.76	0.52

T 23° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	-	-	2.04	2.04
1	2.22	2.22	2.00	-	-	2.25	2.03
2	2.34	2.34	2.34	-	-	2.37	2.03
3	2.46	2.46	2.20	-	-	2.47	2.01
4	2.52	2.62	2.10	-	-	2.62	2.10
			1.0 ppm Cl_2				
0 hr	1.00	1.00	1.00	-	-	1.00	1.00
1	1.09	1.04	1.00	-	-	1.06	1.00
2	1.13	1.11	1.00	-	-	1.13	1.00
3	1.21	1.21	1.00	-	-	1.24	1.03
4	1.34	1.31	1.00	-	-	1.37	1.03
			0.5 ppm Cl_2				
0 hr	0.57	0.58	0.51	0.57	0.50	0.59	0.52
1	0.69	0.67	0.50	0.67	0.50	0.66	0.50
2	0.66	0.66	0.50	0.67	0.51	0.66	0.50
3	0.85	0.84	0.50	0.85	0.50	0.80	0.50
4	0.89	0.90	0.51	0.90	0.51	0.90	0.51

-20-

Effects of NTA upon Chlorination

Type of NTA used: Recrystallised

Location : Providence City Water
pH : 6.5
date : 07 MAY 71

T 23° C

Time	Blank	2.0 ppm Cl_2 4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	204	216	210	207	201	211	205	200	200	200	208	200	200	200
1	220	230	210	231	211	246	226	210	220	210	234	224	240	230
2	257	252	200	240	200	244	200	227	239	212	239	218	245	218
3	258	261	203	250	200	270	228	235	251	216	257	218	262	227
4	245	263	218	260	215	282	237	260	250	200	265	205	305	245
		1.0 ppm Cl_2												
0	118	120	102	122	104	123	105	113	100	100	112	100	120	107
1	152	154	102	142	100	146	100	146	155	109	152	106	152	106
2	156	159	103	153	100	156	100	157	159	102	159	102	164	107
3	161	166	105	161	100	160	100	164	167	103	165	101	170	106
4	169	172	103	171	102	168	101	171	175	104	176	105	181	110
		0.5 ppm Cl_2												
0 hr	056	0.58	052	059	053	061	056	059	060	051	062	053	064	053
	081	093	056	089	053	096	053	085	089	054	092	057	094	059
	092	096	054	096	054	097	055	094	095	051	100	056	097	053
	095	098	053	097	052	099	059	096	>80	>54	096	>50	>98	>53
	097	099	053	>10	>53	>10	>53	098	100	>52	100	>52	>100	>52

ocation : West Kingston, RI
H : 5.8
ate : June 18 1971

Type of NTA used: Recrystallised

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	200	200	200	200	200	200	200
1	200	200	200	202	202	215	218
2	202	213	211	205	203	210	205
3	215	215	200	222	207	233	218
4	200	220	220	228	228	236	236

Time	Blank	4 ppm	1.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
1 hr	100	100	100	100	100	100	100
2	100	104	104	107	107	114	114
3	100	105	105	108	108	110	110
4	105	111	106	115	110	115	110
5	102	115	103	112	100	120	108

Time	Blank	4 ppm	0.5 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	050	052	052	055	055	054	054
1	055	057	052	059	054	060	055
2	055	059	054	060	055	061	056
3	058	065	057	062	059	063	055
4	060	066	056	068	058	064	054

T 23° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	200	200	200	200	200	200	200
1	200	200	200	208	208	214	214
2	202	215	213	230	228	247	245
3	209	232	223	248	239	275	264
4	210	255	245	291	281	307	297

Time	Blank	4 ppm	1.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
1 hr	100	100	100	102	102	103	103
2	100	114	114	121	121	127	127
3	100	127	127	130	130	134	134
4	105	135	130	147	142	154	149
5	105	138	123	158	143	170	155

Time	Blank	4 ppm	0.5 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	050	050	050	052	052	052	052
1	050	064	064	065	065	066	066
2	055	064	059	069	064	070	065
3	065	074	059	076	061	078	063
4	067	077	060	081	064	084	067

B

Type of NTA used; Recrystallized

Location : NEWPORT, R.I.
pH : 7.55
date : JUN 7 1971

T 4° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.04	2.00	2.08	2.15	2.11	2.11	2.07
1	2.48	2.59	2.11	2.61	2.13	2.70	2.22
2	2.62	2.75	2.13	2.79	2.17	2.81	2.19
3	2.77	2.88	2.11	2.90	2.13	3.00	2.23
4	2.89	2.95	2.06	2.95	2.06	2.98	2.09
			1.0 ppm Cl_2				
0 hr	1.00	1.02	1.02	1.01	1.01	1.07	1.07
1	1.19	1.23	1.04	1.26	1.07	1.27	1.08
2	1.29	1.39	1.00	1.31	1.02	1.34	1.05
3	1.31	1.35	1.06	1.36	1.05	1.38	1.07
4	1.31	1.36	1.05	1.37	1.06	1.38	1.07
			0.5 ppm Cl_2				
0 hr	0.50	0.51	0.51	0.50	0.58	0.52	0.52
1	0.65	0.74	0.59	0.70	0.55	0.75	0.60
2	0.70	0.74	0.54	0.75	0.55	0.77	0.57
3	0.75	0.77	0.52	0.76	0.51	0.83	0.58
4	0.79	0.81	0.52	0.82	0.53	0.83	0.54

T 23° C

Time	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.32	2.37	2.05	2.35	2.03	2.36	2.04
1	2.79	2.76	2.03	2.77	2.03	2.81	2.02
2	2.93	2.93	2.00	2.96	2.03	2.98	2.05
3	3.05	3.09	2.04	3.10	2.05	3.15	2.10
4	3.09	3.10	2.01	3.15	2.06	3.16	2.07
			1.0 ppm Cl_2				
0 hr	1.06	1.10	1.04	1.10	1.04	1.12	1.06
1	1.24	1.24	1.00	1.29	1.05	1.31	1.07
2	1.40	1.38	1.00	1.41	1.01	1.43	1.03
3	1.46	1.48	1.02	1.48	1.02	1.49	1.03
4	1.47	1.50	1.03	1.50	1.03	1.51	1.04
			0.5 ppm Cl_2				
0 hr	0.50	0.55	0.55	0.58	0.58	0.60	0.60
1	0.81	0.81					
2							
3							
4							

Too Great a demand to measure accurately.

-23-

Effects of NTA upon Chlorination

cation : NEWHL TAP WATER — Type of NTA used: Recrystallized
: 6.6
te : MAY 1971

T 4° C

e	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
				2.0 ppm Cl_2			
hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1	2.00	2.00	2.00	2.00	2.00	2.02	2.03
2	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	2.00	2.00	2.00	2.00	2.00	2.03	2.03
	2.00	2.00	2.00	2.00	2.00	2.01	2.01
				1.0 ppm Cl_2			
hr	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00
				0.5 ppm Cl_2			
hr	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1	0.50	0.50	0.50	0.50	0.50	0.50	0.50
2	0.50	0.50	0.50	0.50	0.50	0.50	0.50
3	0.50	0.50	0.50	0.50	0.50	0.50	0.50
4	0.50	0.50	0.50	0.50	0.50	0.50	0.50

T 23° C

Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
2.00	2.00	3.00	2.00	2.00	2.00	2.00
2.00	2.00	3.00	2.00	2.00	2.00	2.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.02	1.02	1.00	1.00
1.00	1.00	1.00	1.05	1.05	1.05	1.05
1.00	1.00	1.00	1.00	1.12	1.12	1.12
1.00	1.05	1.05	1.20	1.20	1.35	1.35
0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.50	0.51	0.51	0.52	0.52	0.53	0.53
0.50	0.53	0.53	0.53	0.53	0.56	0.56

Effects of NTA upon Chlorination

Type of NTA used: Recrystallized

ocation : North Kingstown, R.I.
:
ate : MAY 4 1971

T 4° C

ime	Blank	4 ppm	2.0 ppm Cl_2 Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2	2.00	2.00	2.00	2.00	2.00	2.08	2.08
3	2.00	2.00	2.00	2.04	2.04	2.10	2.10
4	2.00	2.00	2.00	2.10	2.10	2.12	2.12
			1.0 ppm Cl_2				
0 hr	1.05	1.05	1.00	1.02	1.00	1.02	1.00
1	1.03	1.08	1.05	1.06	1.03	1.07	1.04
2	1.07	1.08	1.01	1.11	1.04	1.15	1.08
3	1.10	1.12	1.02	1.13	1.03	1.16	1.06
4	1.05	1.08	1.03	1.08	1.03	1.09	1.04
			0.5 ppm Cl_2				
0 hr	0.57	0.50	0.50	—	—	0.52	0.51
1	0.51	0.53	0.52	—	—	0.54	0.53
2	0.54	0.56	0.52	—	—	0.59	0.55
3	0.54	0.56	0.52	—	—	0.59	0.55
4	0.57	0.59	0.52	—	—	0.59	0.54

T 23° C

Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
2.00	2.00	2.00	2.00	2.00	2.00	2.00
2.00	2.00	2.00	2.17	2.17	2.34	2.34
2.00	2.15	2.15	2.41	2.41	2.55	2.55
2.00	2.32	2.32	2.80	2.80	2.85	2.85
2.02	2.47	2.45	2.92	2.90	3.25	3.23
1.02	1.04	1.02	1.02	1.00	1.03	1.01
1.05	1.06	1.01	1.06	1.01	1.10	1.05
1.08	1.18	1.10	1.16	1.08	1.43	1.35
1.10	1.39	1.29	1.42	1.32	1.81	1.71
1.10	1.58	1.40	1.51	1.41	1.95	1.85
0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.55	0.58	0.53	0.58	0.53	0.62	0.57
0.55	0.60	0.55	0.60	0.55	0.70	0.65
0.57	0.65	0.58	0.66	0.59	0.71	0.64
0.55	0.71	0.66	0.71	0.66	0.28	0.77

25-1

Effects of NTA upon Chlorination

Type of NTA used: Recrystallised

Location : Woonsocket, RI.
pH : 6.0
Date : Jan 17 1971

T 4° C

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
		(Dose initially @ 2mg/L Cl_2 + 8ml excess)		2.0 ppm Cl_2			
0 hr	2.06	2.13	2.07	2.19	2.13	2.25	2.19
1	3.05	3.12	2.07	3.08	2.03	3.13	2.08
2	3.48	3.56	2.08	3.55	2.07	3.56	2.08
3	3.27	3.36	2.09	3.24	2.07	2.30	2.03
4	3.64	3.68	2.04	3.66	2.02	3.72	2.08
				1.0 ppm Cl_2			
0 hr							
1				INITIAL DEMANDS TOO HIGH FOR INCREASE IN NTA DEMAND			
2							
3							
4							
				0.5 ppm Cl_2			
0 hr							
1							
2							
3							
4							

T 23° C

Time	Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
0 hr	2.45	2.30	2.00	2.55	2.10	2.50	2.05
1	3.45	3.69	2.21	2.75	2.30	2.77	2.32
2	3.90	>.4	-	-	-	-	-
3			REMOVED TOO HIGH				
4							

Effects of NTA upon chlorination

Type of NTA used: Recrystallised

Location : Spring Lake, R.I.
pH : 6.0
date : May 1971

Time	T 4° C Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm	T 23° C Blank	4 ppm	Corr'd 4 ppm	10 ppm	Corr'd 10 ppm	25 ppm	Corr'd 25 ppm
2.0 ppm Cl_2														
0 hr	2.00	2.00	2.00	2.08	2.08	2.09	2.09	2.20	2.25	2.05	2.30	2.10	2.37	2.17
1	2.39	2.42	2.02	2.49	2.10	2.55	2.06	2.60	2.65	2.05	2.70	2.10	2.78	2.18
2	2.49	2.42	2.00	2.58	2.09	2.61	2.11	2.82	2.87	2.05	2.91	2.09	3.04	2.22
3	2.60	2.66	2.05	2.75	2.10	2.88	2.22	2.92	3.07	2.15	3.15	2.23	3.36	2.44
4	2.69	2.79	2.20	2.70	2.11	2.79	2.20	3.02	3.07	2.05	3.20	2.18	3.35	2.33
1.0 ppm Cl_2														
0 hr	1.32	1.33	1.01	1.36	1.04	1.32	1.00	1.20	1.25	1.05	1.35	1.15	1.40	1.20
1	1.73	1.74	1.01	1.77	1.04	1.80	1.07	1.26	1.40	1.14	1.52	1.26	1.65	1.39
2	1.83	1.83	1.00	1.84	1.01	1.88	1.05	1.30	1.53	1.23	1.66	1.36	1.78	1.48
3	1.86	1.90	1.04	1.90	1.04	1.93	1.07	1.40	1.65	1.25	1.75	1.35	1.85	1.45
4	1.89	1.91	1.02	1.90	1.01	1.96	1.07	1.44	1.72	1.28	1.90	1.46	1.92	1.48
0.5 ppm Cl_2														
	(DOSE INITIALLY = 1 MG/L Cl_2 , WAIT 3 HR. DOSE = 0.5 MG/L)													
0 hr	0.50	0.59	0.59	0.60	0.60	0.67	0.67	0.50	0.50	0.50	0.54	0.54	0.57	0.57
1	0.50	0.69	0.69	0.55	0.55	0.68	0.68	0.50	0.51	0.51	0.58	0.58	0.62	0.62
2	0.50	0.79	0.79	0.56	0.56	0.74	0.74	0.50	0.50	0.50	0.64	0.64	0.75	0.75
3	0.51	0.77	0.78	0.70	0.69	0.80	0.79				—			
4	0.54	0.74	0.70	0.61	0.57	0.79	0.75				—			

C

SPECIAL STUDY
EFFECTS ON NTA IRON STANDING (IN WATER) CHELATANTS IMMEDIATELY PRIOR TO TITRATION

NEWHL WATER @ 15°C, ph 6.6
1 mg/L Cl_2 Commercial NTA

+10	BLK	4ppm	10ppm	25ppm
0 hr	1.00	1.00	1.00	1.00
1	1.00	1.00	1.00	1.08
2	1.00	1.00	1.03	1.02
3	1.00	1.00	1.00	1.04
4	1.00	1.00	1.00	1.03

2x Glass Dist. H_2O @ 23°C, ph 5.25
1 mg/L Cl_2 Re-Chlor. N.T.A.

BLK	4ppm	10ppm	25ppm
1.00	–	–	1.00
1.00	–	–	1.00
1.08	–	–	1.00
1.00	–	–	1.00
1.00	–	–	1.02

PROVIDENCE WATER
T=23°C, ph=10, 1 mg/L Cl_2
Re-Chlor. N.T.A.

BLK	25ppm	25ppm Comm
1.04	1.06	1.02
1.04	1.07	1.03
1.04	1.07	1.03
1.04	1.08	1.04
1.04	1.10	1.06

Potomac R. H_2O T=23°C ph=6.9
1 mg/L Cl_2* Comm. N.T.A.

BLK	25ppm	25ppm Comm
1.70	1.20	1.00
1.70	1.21	1.01
1.70	1.25	1.05
1.70	1.25	1.05
1.70	1.26	1.06

* ph adjusted to 6 mg/L Cl_2

West Kingston Well H_2O, ph = 5.8
T = 23°C 1 ppm Comm. N.T.A.

BLK	25ppm	25ppm Comm
1.00	1.04	1.04
1.00	1.03	1.03
1.00	1.02	1.02
1.00	1.02	1.02
1.00	1.02	1.02

PROVIDENCE WATER, T=15°C
ph = 6.5 Re-X. N.T.A. 1 ppm Cl_2

1.18	1.18	1.00
1.18	1.20	1.02
1.18	1.18	1.00
1.18	1.18	1.00
1.18	1.18	1.00

8-